Office of Safety and
Mission Assurance
Annual Review Report

Science and Engineering Technical Assessments (SETA) Program

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Foreword

This document describes concerns and issues raised during the IV&V Facility's Annual Review presentation to the NASA Office of Safety and Mission Assurance.

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1 Introduction

On November 18, 1999, the NASA/Ames Independent Verification and Validation (IV&V) Facility presented their Annual Review Presentation to the Office of Safety and Mission Assurance (OSMA) in Washington, DC. This meeting was designed to report on IV&V Facility accomplishments achieved through activities funded by OSMA. The meeting was originally scheduled for 9:00 a.m. to 12:00 noon and was shortened due to scheduling conflicts. The actual time for the meeting was approximately 9:15 a.m. to 11:15 a.m.

Several questions and concerns were brought forth during the course of the meeting. This report contains recommendations for addressing the action items requested as well as some of the issues that arose.

Attendee	Organization
Dr. Louis Blazy	NASA IV&V Facility
Cynthia Calhoun*	NASA IV&V Facility
Ken Costello (telecon)	NASA IV&V Facility
Marcus Fisher (telecon)	NASA IV&V Facility
Dr. Michael Greenfield	NASA OSMA
Melanie Gould*	D.N. American/SETA Contract
Frank Huy (telecon)	D.N. American/SETA Contract
Tim Menzies*	West Virginia University
Phil Napala	NASA OSMA
Pam Richardson	NASA OSMA
Edward Weed (telecon)	D.N. American/SETA Contract
Siamak Yassini*	NASA IV&V Facility

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* Indicates presenter.

2 Center Initiative Overview

Siamak Yassini began the IV&V Facility's OSMA Annual Review presentation with a summary of the budgetary and schedule status of the OSMA Software Program activities.

2.1 Issues

Concern

The layout of the "Focus Areas" for the Center Initiatives (CIs) raised several questions from Dr. Greenfield. These included concern over whether all CIs were considered to be under "software assurance," since it was not called out as a separate category, and whether or not each CI would be described in detail since they were categorized by theme on three introductory slides.

Analysis

The IV&V Facility has historically spent a great deal of time on making presentation packets audience specific and concise, thus getting to the "meat" of the information as quickly as possible. In this briefing, the CIs are accompanied by several introductory slides showing status, NASA Enterprise penetration, and funding. This inevitably leads to some repetitive material.

Recommendation

It is recommended that the thematic division of the CIs be incorporated into the "Summary of Enterprise Penetration" section (slides 7-8). It is not necessary to divide the CIs by center in this table since they are divided in that manner on the subsequent funding chart (slide 9). This would eliminate some of the redundancies in these introductory slides and move the presentation more quickly to the detailed information that Dr. Greenfield would like to see.

Furthermore, it is suggested that it be made clear that Software Assurance is an overall theme for all CIs.

2.2 Questions Posed by Dr. Greenfield

Question	Topic & Slide	Summary of Response[1]
How many years do CIs usually take?	Summary of Center Initiatives (5)	SY responded that CIs are usually one to three years with an average duration of two years.
Did we work with the CIO office on the NPD 2820 Metrics effort?	Summary of Enterprise Penetration (7)	SY responded that Ted Hammer from Goddard Space Flight Center worked on this CI.
What is the money allocated to Headquarters?	FY99 Center Initiatives (9)	SY indicated that this money was returned because it was "over guideline"(?) He also indicated that it came back to the IV&V Facility this year.

3 WVU/IV&V Facility Research Program FY99-00 & IV&V Facility Center Initiatives

Tim Menzies of West Virginia University presented the status of their research efforts and of CIs performed by IV&V Facility personnel. Dr. Greenfield expressed great interest in this portion of the presentation and responded favorably to the information and the presenter.

3.1 Issues

Concern

Dr. Greenfield expressed great interest in the application of the Quality Enabling Software Technologies (QuEST) toolkit to a NASA project. The principal investigator stated that such a case study would be occurring in the future.

Analysis

At the time of SETA's assessment of the QuEST CI, it appeared that QuEST was not an activity that the IV&V Facility was interested in pursuing due to some legal issues with the Microelectronics & Computer Technology Corporation (MCC). However, it now appears that the IV&V Facility is committed to conducting a case study. Since the CI has been officially closed, there does not appear to be money for the study to be performed through CI funding.

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[1] SY=Siamak Yassini, LB=Dr. Louis Blazy, TM=Tim Menzies, CC=Cynthia Calhoun, KC=Ken Costello

Recommendation

It is recommended that the Principal Investigator guide the case study using one of the following options:

1. The SETA Program conducted the assessment of the QuEST initiative, which required a familiarity with the toolkit. The SETA Program, therefore, has a background with the tool that positions them to be of value in conducting the case study.

2. QuEST is not unlike McCabe, Rational Rose, or any other such CASE tool. It is feasible that a student intern would be able to conduct the case study given appropriate learning time. However, it is uncertain if the status of the principal investigator as a student co-op would conflict with status as a student mentor, thus prohibiting this scenario.

Concern

In several cases, there appears to be some confusion over what is being produced by CIs and what is being purchased. Examples of this include: QuEST and the Software Productivity Consortium (SPC).

Analysis

In both QuEST and the SPC CIs, it is stated in the slides that there are "products delivered." During the SPC presentation by Tim Menzies, it was stated that "these are the products being produced." This is an inaccurate statement made by a presenter who is not familiar, on a day-to-day basis, with that particular CI. While it is true that "products" are being delivered, there is no way to tell from the presentation materials which products are developed and produced as a result of the CI funding and other products which are purchased by the CI funding. This leads to potential confusion for people who do not have a detailed understanding of each CI (e.g. Dr. Greenfield and "substitute" presenters).

Recommendation

It is recommended that a distinction be made, within the presentation packet, between products produced by CI activities and products purchased by CI funding.

3.2 Questions Posed by Dr. Greenfield

Question	Topic & Slide	Summary of Response
Is Software Risk Assessment CI for risk assessment or identification? Is it useable now or in research stage? Is it a continuum? Is some being applied now? Does COCOMO give false risk identifications?	Software Risk Assessment (16)	Discussion with TM and LB indicated that this work is being continually refined as it is being used. As lessons are learned from the application process, they are incorporated back into the research to add additional focus. Dr. Greenfield indicated that he felt this was a balanced approach especially with the application of CARA analysis.
Is ROI being done to advocate IV&V or to size the amount of IV&V for appropriate return? Are you working to understand how much money is worth investing in IV&V? What is your timeframe?	Software Metrics & Return on Investment (ROI) (18)	TM stated that the ROI work is not necessarily to advocate IV&V because the results could be negative. The work is being performed in order to know when the application of IV&V is cost effective. The timeframe for this effort is within the year.
Is this to aid design to build higher reliability software? For new software? Is there a lot of data available on latent errors in new software releases?	Software Reliability (19)	TM responded that with all new software there is always "X" number of errors expected. This work could be applied to a COTS IV&V survey to predict latent errors, but that it needs to be fine-tuned to the particulars.
Are we any closer to using the system? Are we dedicated to going to three string GPS?	Specification-based Testing (23)	LB and TM responded to questions in this area. The discussion indicated that $250K was being put into MAGR and that Averstar is working with information provided from WVU research.

3.3 Action Items

Action Item & Actionee
Send Dr. Greenfield a copy of the Workshop on Risk Management (WoRM) 99 workshop proceedings - Dr. Blazy

Context & Recommended Action
During the discussion on the Software Risk Assessment research work (slide 16), Dr. Blazy mentioned WoRM 99. A brief discussion ensued on the success of the workshop and Dr. Greenfield indicated that he would like to obtain a complete copy of the proceedings. Dr. Blazy responded that he would provide them as soon as possible. It is recommended that the complete packet be sent.

4 Center Initiatives from Other Centers

Siamak Yassini presented information on all CI efforts not being performed by IV&V Facility personnel. This area of the presentation raised the most questions and issues from Dr. Greenfield. Because the IV&V Facility manages these CIs "remotely," this has been an area of consistent concern.

4.1 Issues

Concern

The quality review of CI products was of great interest to Dr. Greenfield. It was suggested that rigorous review be conducted of all CI products and that a "great deal" be returned to the authors in order to enforce a higher standard for the products that are delivered.

Analysis

Over the past year and a half, the IV&V Facility has begun to look more closely at the CI products that are delivered. As products come in to the IV&V Facility they are being reviewed either by one of the NASA staff members or by a member of the SETA contract personnel. For the General Management Reviews (GMRs) and the OSMA Annual Review, the products that are reviewed by SETA personnel have been reported under SETA accomplishments. It is unclear where products reviewed by NASA personnel have been reported. This leads to inconsistencies in reporting for the deliverables and an incomplete picture of the work that the IV&V Facility's personnel have been performing.

Recommendation

It is suggested that the IV&V Facility develop a methodology for tracking: (1) CI products that are reviewed, (2) reviewers, and (3) accept/reject responses. This information should be included in the CI information reported in each GMR and in the Annual Review. By putting the information within each CI description, it will be easy for Dr. Greenfield to see which CIs have been producing acceptable products and who has been evaluating their success.

Concern

Technology transfer of products developed under CIs is a vital part of the CI mission. This was expressed multiple times by Dr. Greenfield. It was indicated that he does not feel that this has been done effectively in the past and would like to ensure that products are being used by centers, not just developed. It was expressed that this is not a concern for the Jet Propulsion Laboratory (JPL) and Goddard Space Flight Center (GSFC) because they can often use their own developments. Furthermore, Dr. Greenfield expressed concern (during the Advanced Software Fault Tolerance Strategies for Mission Critical Spacecraft

Applications presentation) about CIs not asking for follow-on funding because he was concerned that their tool/developments would "get lost."

Analysis
When CIs are proposed, it is required that they provide a description of the anticipated application of the technology/methodology within a NASA project. Unfortunately, there is no clear tracking mechanism to report progress for that technology transfer. In some cases, it is reported within the CI status and in other cases it is reported within CI deliverables as a pilot project documentation title. Because this is an area that is critical to CI selection and is so important to Dr. Greenfield, it should be tracked more closely and consistently.

Recommendation
It is recommended that the IV&V Facility develop a plan for ensuring that the CI products are indeed transferred to projects for use. This could be as simple as a tracking table that traces a product from delivery, through the review cycle, to implementation on a project, and that concludes with a brief implementation assessment or comments from the project manager who used the product.

It is envisioned that this tracking table would be combined with the methodology for tracking the review of CI products.

Concern
Dr. Greenfield expressed a need for a way to ensure that program managers were making the right decisions on funding allocation to ensure all areas of the project were covered (software, hardware, testing, research, etc).

Analysis
This is an industry-wide area of concern, not NASA specific. Therefore, it is expected that there is a body of work available to aid in the development of a cost scheduling/allocation methodology that is NASA specific.

The Software Engineering Institute (SEI) at Carnegie Mellon University (CMU) has developed the Personal Software Process (PSP) which includes, among other things, the use of *Cost of Quality* to manage quality and effectiveness. PSP measures appraisal, failure, and prevention costs. The cost measures that are included in these three areas are compiled from project costs in various areas. This *type* of existing work could be the foundation for a study to build the methodology that Dr. Greenfield is requesting.

Recommendation
It is recommended that the IV&V Facility consider conducting further research in this area. A preliminary study of available information could be performed

through the SETA Program. Any gaps found or remaining information that is needed could then be developed through the SETA Program or through a CI effort, depending on scope and available funding.

Concern

One concern that would potentially prevent future problems is ensuring that the language used on all slides is clear in detail. For example, slide 39 states "Support the V&V effort of the In-Situ Propellant Plant (ISPP) at Kennedy Space Center." Dr. Greenfield questioned this and further discussion revealed that it is the plant to be placed on Mars.

Analysis

Ensuring that the information presented is unambiguous would prevent confusion for those referencing the slide presentation after the meeting and eliminate the need for such questions during the meeting.

Recommendation

It is suggested that during presentation dry runs, the audience include at least one person who is not familiar with the projects in order to elicit questions that are "clarification" type issues. These are questions that slow the presentation, but can easily be answered through simple wording changes.

4.2 Questions Posed by Dr. Greenfield

Question	Topic & Slide	Summary of Response
Are these metrics to be used? Are they good numbers?	Engineering Reliability into SW Products Through Metrics (45)	SY responded that the metrics are being used and that the numbers are good.
Are we sending money to SATC? Do they have deliverables? Do they have funding from other sources? How many people are in SATC? Do we use JAVA on spacecraft?	Software Assurance Technology Center (46)	SY responded that we are sending money to SATC, but we are not their only source of funding. SATC does provide us with deliverables. There are approximately 79 people in SATC. During the discussion on Java, KC indicated that CLCS is using Java, but we have concerns about that since most space systems are using Ada and/or C++.
Shouldn't confidence in auto-code generators be a more significant thrust? Isn't there a need for tools to give us added confidence outside of the development testing? What is the paradigm?	Automatic Software Code Generator (61)	LB indicated that this is an area of great interest for the IV&V Facility and that we are currently working on developing the paradigm to be used.

Question	Topic & Slide	Summary of Response
Where did "Pete" come from?	Software Planning Expert System – *Ask Pete* (76)	SY responded that we were not certain on the origin of the name. Martha Wetherholt is the developer and it was her choice.
Which IS? What is the current funding for IS?	CI Technical/Management Issues (82)	LB indicated that this was the IS effort from Ames. Steve Zornetzer has looked at providing some funding for the IV&V Facility depending on the amount that Ames receives. The level of funding for IS is still uncertain. Dr. Greenfield suggested that, in future negotiations, LB should request a percentage of the total funds rather than a flat funding amount.

4.3 Action Items

Action Item & Actionee
Highlight interfaces between research and industry – Project Personnel

Context & Recommended Action
During the discussions on CIs, Dr. Greenfield repeatedly emphasized the importance of technology transfer to industry. It was directly requested, during the discussion on "Specification-based Testing," that the IV&V Facility highlight the interfaces with industry because it is a key reason for facility funding.

Section 2.1 of this document contains a description of the same concern in relation to the CIs. This action item expands that concern to cover WVU and NASA research activities as well.

It is recommended that the Point of Contact (POC) for each project include, in their status, technology transferred from research to industry/NASA projects. The research efforts can be tracked on a table much like the one suggested for the CI efforts.

Action Item & Actionee
Hold discussion with Dr. Greenfield on issue of balancing number of CIs with available budget (before May 2000) – Dr. Blazy

reflective of what our emphasis should be, per Dr. Greenfield. In his opinion, there should be a more prominent mention of "safety" as a mission of the IV&V Facility.

Analysis
Changing the mission and goals has presented a logistical problem in the past; there are several locations in which the updates must be made. However, the IV&V Facility is in the midst of updating the Operations Plan for the new year. This makes the timing appropriate for any necessary changes to the mission.

Recommendation
It is suggested that this statement be reworded as follows: "Increase software safety and quality, reduce software costs, and improve delivery time through the early detection and resolution of errors, and by utilizing and applying empirically based software engineering best practices."

This new phrasing should be applied in all instances where the IV&V Facility mission has been used. These include, but are not limited to: briefings, the IV&V Facility web sites, and the Code I web site (send to Gaye Graves at Ames).

6.2 Questions Posed by Dr. Greenfield
There were questions posed by Dr. Greenfield during the web demonstration, however they were not captured on paper (The presenter was also responsible for recording the meeting proceedings.).

7 Summary
Overall, the presentation was successful in that Dr. Greenfield appeared pleased and provided verbal praise for the IV&V Facility for having made great strides over the last year. Dr. Greenfield's response to several IV&V Facility actions and suggestions was positive including: the hiring of Tom Mitchell of CMU as a consultant, the LaRC Process Verification (upon seeing results, Dr. Greenfield gave them an additional software person for staff), and the enthusiasm and expertise of several staff members and principal investigators.

Dr. Greenfield continues to express confidence in the abilities of the IV&V Facility's staff and looks for them to further enhance their management of activities receiving OSMA funding. To that end, it is critical that future briefings emphasize the technology transfer of products developed and provide evidence of CI deliverable quality reviews.

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SETA contract personnel noted the following overall issue for the presentation.

Concern

Changes in presentation duration and several other high priority events for the IV&V Facility resulted in a shortened presentation and contributed to errors in the presentation. Specific instances are as follows:

1. Instead of 96 slides for a three-hour presentation, there were 96 slides for a two hour presentation.
2. Changes were requested within the SETA section of the presentation. These changes were not incorporated. (Reference October 21, 1999 e-mail from Cynthia Calhoun)
3. Multiple format errors throughout the presentation (i.e. font (slide 7), page number overlap on table (slide 5-7), acronyms not spelled out (multiple slides), text spacing (slide 65), title spacing (slide 30 & 65), partial full justification (slide 80), use of IVVF for IV&V Facility (slides 92-95)).
4. A statement was made that the SAIC Risk Cube methodology was used on the Boeing 757 independent assessment for Langley Research Center (LaRC). While it is true that the Risk Cube was initially used, it should be clarified that the assessment that was delivered to the customer did not employ the Risk Cube methodology. Due to the proprietary information issue, the independent assessment results using the Risk Cube were omitted and results from the IV&V Facility's Criticality Analysis and Risk Assessment (CARA) method were incorporated into the final report that was delivered to the customer.
5. Use of Lewis Research Center instead of Glenn Research Center (e.g. slides 73-78).

Analysis

Many of these instances could be eliminated through a thorough review of the complete presentation after all changes have been incorporated. However, the errors during the presentation can largely be attributed to the change in meeting duration, which resulted in a rushed briefing.

Recommendation

It is recommended that future presentations are developed with key slides and "back-up" slides so presenters have advanced awareness of which slides are critical to their presentations. This would mitigate the need to make real-time decisions concerning which materials can be omitted or "glossed over."

Ideally, major changes to the presentation structure and content should not be made in the days immediately prior to the actual briefing. These decisions should be made and finalized well ahead of the briefing date. This would allow sufficient time to detect and fix all the minor formatting, spacing, and typographical errors that inevitably result when many people are involved in contributing slides to a large presentation.

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13. ABSTRACT *(Maximum 200 words)*

This document summarizes questions and concerns raised during the 1999 IV&V Facility's Annual Review Presentation to the Office of Safety and Mission Assurance (OSMA). Recommendations are provided for issues and action items identified.

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